# POPULATION DECLINE OF AN INSULAR POPULATION OF ARMENIAN WILD SHEEP IN IRAN[1]

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*Abstract:* From 1970 to 1973, an insular population of Armenian wild sheep (*Ovis orientalis gmelinii*) in an area of 3145 hectares declined from an estimated 3500 to 1000. The dry spring and summer of 1971, the severe winter of 1971–72, and the poor range conditions engendered by heavy overstocking were the major factors contributing to the 1971–72 die-off. During that die-off less than 1 percent of the lamb crop survived. Net productivity during 1971, 1972, and 1973 was 14 percent, less than 1 percent, and 15 percent respectively. Under present poor range conditions, the recommended population level is 500 animals.

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Kabudan Island, situated in northwestern Iran (Fig. 1), is inhabitated by a population of Armenian wild sheep which were introduced in unknown numbers from the mainland in the nineteenth century (Nasonov 1923). When the island was declared a wildlife refuge in 1967, all domestic sheep and goat grazing was prohibited. Except for 2 game wardens who patrol the area, there are no permanent human inhabitants on the island. To establish natural predation, an adult male and female leopard (*Panthera pardus*) trapped in northeastern Iran were introduced on the island in 1969. Limited hunting of wild sheep was allowed on the island until 1973.

The population dynamics of the wild sheep population were documented between May 1971 and May 1975. We thank the Iran Department of the Environment field personnel for their assistance and in particular the Director, H. E. Eskandar Firouz, for his support of these studies.

## STUDY AREA

Kabudan Island (37°28′N; 45°37′E) is located in Lake Rezaiyeh within the Lake Rezaiyeh National Park (Fig. 1) and encompasses 3145 hectares. Lake Rezaiyeh is a highly saline body of water 1290 meters above sea level. The topography of the island is characterized by precipitous rocky cliffs and rolling hills with intermittant valleys oriented principally in an east-west direction.

The climate is characterized by warm summers and cold winters; temperatures range from 37 C in the summer to −18 C in the winter. There is a prevailing northerly wind. Average annual precipitation for the period between 1971 and 1973 was 247 mm (1971, 257 mm; 1972, 301 mm; 1973, 185 mm). It falls as both rain and snow, more than 75 percent in the fall and winter. Ganji (1968) reported an average of 370 mm (14.5 inches) for a 15-year period for Rezaiyeh, a city on the mainland about 50 kilometers northwest of Kabudan Island. The short period for which weather data is available for the island is not sufficient for estimation of a long-term average. We estimate that 300–400 mm would be a more accurate long-term estimate.

The vegetation is steppe, although in certain areas scattered pistachio trees (*Pistacia*

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Fig. 1. Location of study area within Lake Rezaiyeh in northwestern Iran and map of Kabudan Island.

*mutica*) create a savanna-like appearance. The principal grass and grasslike species in terms of cover are *Poa bulbosa, Carex stenophylla, Stipa barbata, Bromus tectorum,* and *Hordeum murinum.* The major woody species are *Artemisia herba-alba, Ephedra procera, Juniperus* sp., and *Rosa* sp. An *Artemisia-Carex-Poa* association predominates.

## METHODS

### Trapping

In order to weigh, measure, and mark animals, a trapping program was initiated in the summer of 1971. A pole trapping corral and a solid-walled holding pen were constructed around each of the two springs (Fig. 1). The springs were the only sources of fresh water during the late summer and early fall. We found, particularly at Kariz but also occasionally at Dom-Domeh, that when left unmolested and confronted with a closed trap, sheep would paw and push at the poles until they knocked down a pole or found a large enough gap between poles through which they could enter. Once they had used a gap and even after we had repaired it, they would persistently return to that spot in the fence and paw at the fence, despite the fact that they were standing within 4 meters of the open main gate.

We used this behavior to design a self-trapping device (Fig. 2). First, the sheep

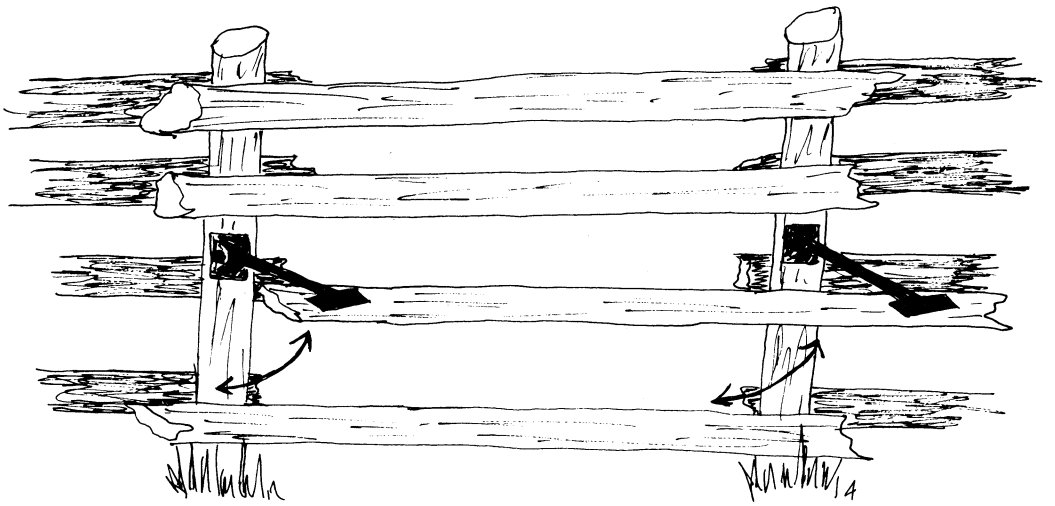

Fig. 2. Wild sheep self-trapping device.

were "trained" to use a specific hole in the fence by knocking several poles out of the fence at a spot previously used by the sheep to enter the trap. They quickly adjusted to this and moved freely in and out of the trap through the gap. We then constructed a swinging gate over the gap consisting of moveable arms attached to the upright poles and connected by a cross-pole. When the cross-pole was pushed or butted by a sheep, it would swing inwards and upwards allowing the animal to enter the trap. Once the sheep was in, the pole fell back in place and the animal could not get out, though lambs occasionally escaped by jumping out when another animal was entering. This device had the tremendous advantage of not frightening the animals; they did not panic inside the trap; and they did not associate the swinging bar with being trapped. In the evening we could move the captured sheep into the holding pen, rope them, attach plastic ear tags and nylon impregnated vinyl collars, weigh, measure, and then release them.

## Counts

Annual counts of island sheep have been made since 1969. Ten to 20 people walked in line abreast, starting from the eastern end of the island. Each counted those sheep which crossed the line (toward the east) between himself and the person on his left. They proceeded to the base of Kareh Dagh peninsula. Leaving enough people to count sheep passing from the peninsula to the main part of the island, several others moved by boat to the western tip, and drove all sheep past the counting line. The precision of such a technique depends on the number of people participating and their ability to maintain a straight line and to be in constant view of each other.

## Fetal Rate Studies

In order to obtain comparative fetal rate data the reproductive tracts of 86 shot ewes were examined and the fetuses removed and preserved in 10 percent formalin. The ewes were collected on the following dates: 14 April–17 May 1972, 61 ewes; 10–18 April 1975, 25 ewes.

Table 1. Actual number counted and adjusted estimates of wild sheep counts on Kabudan Island.

| Month | Year | No. Counted | Adjusted No. |
|---|---|---|---|
| Nov. | 1969 | 2482[a] | — |
| Aug. | 1970 | 2631[b] | 3500 |
| Aug. | 1971 | 1865 | 2000 |
| Aug. | 1972 | 920 | 1000 |
| Aug. | 1973 | 1038 | 1050 |
| Aug. | 1974 | 984 | 1000 |
| Oct. | 1975 | 903[c] | 925 |

[a] Bosch (1969)
[b] Bosch (1970)
[c] Mowlavi (1975)

Table 2. Losses of wild sheep on Kabudan Island from August 1971 to August 1972.

| | |
|---|---|
| Removed from Island | 109 |
| Trapping Mortality | 30 |
| Lamb Mortality | 200 |
| Hunting Mortality | 120 |
| Productivity Study | 73 |
| Leopard Predation (3 leopards killing 1 sheep/week) | 150 |
| Accounted Losses | 682 |
| Unaccounted Losses | 318 |
| Total | 1000 |

## RESULTS

### Counts

Table 1 shows that in all cases, count figures were adjusted upward. We never observed a group coming from behind through the line of counters so duplication probably never occurred. However, small groups of sheep could pass through the line undetected because the count participants sometimes failed to keep a straight line or remain in view of each other and hence the upward adjusted estimates.

### Mortality

A survey conducted in March 1971 (Noll 1971) revealed the presence of at least 1 young leopard. The original female leopard was found dead in December 1972. Subsequent surveys of the leopard population in 1972 and 1974 by myself and Joslin (personal communication) revealed no more than 3 leopards. Schaller (1973) estimated that an African leopard consumed between 1000 and 1200 kg of meat per year. In 1973 the average weight of 34 female sheep 4 years of age or older was 29 kg and that of 22 males (all ages excluding lambs) was 32 kg. If the average island sheep weighed about 30 kg, a leopard would kill about 40 animals per year. A liberal estimate of 1 sheep per leopard per week was used in calculating leopard predation.

Assuming 3500 sheep on Kabudan Island in August 1970, and 2000 in August 1971, at least 1500 animals died in this period. Between August 1971, and August 1972, the population lost 1000 more animals (Table 2). Between 1972 and 1975, the population stabilized at about 1000 animals (Table 1).

The mortality figures are underestimates since they do not include lambs. Data on lamb numbers are not available, but, based on the number of lambs surviving to age 1 (see following sections), survival was low. A conservative estimate of 200 lambs died each year. In 1972 when net productivity was less than 1 percent, most of the lamb crop died, conservatively estimated at 400.

### Net Productivity and Fetal Rates

Net productivity was calculated from the ratio of yearlings to adult ewes trapped. We chose yearlings rather than lambs for estimating net productivity because lambs readily escaped through the cross poles of the trapping corrals. Also, trapping commenced approximately 3 months after lambing which did not allow a sufficent lapse of time to assess lamb mortality completely. Robinette (1956) recommended that productivity based on fawn survival of North American mule deer (*Odocoileus hemionus*) should be estimated at least 5 months after fawning.

For 1971, trapping data are available for 54 adults and 9 yearling ewes which yield a

net productivity of 14 percent. Only 1 of 38 ewes trapped in 1972 was a yearling. This dramatic drop compared with the previous year was also evident during the mating behavior studies in December 1972. Although we saw more than 90 sheep at 1 time on various days, we never saw more than 1 yearling ram; it was not possible to differentiate yearling ewes from adult ewes at a distance. Thus the net productivity of the island herd for 1972 was probably less than 1 percent. Out of 48 ewes trapped in 1973, 7 were yearlings, for an estimated net productivity of 15 percent.

Valdez (1976) established that fetal rates of wild sheep populations in Iran are as high as 1.38, approaching those of mule deer (*Odocoileus hemionus*) in the United States (Robinette 1956). For this reason, net productivity of the island sheep is compared here to that of cervid populations in the United States rather than North American wild sheep (*O. canadensis*) which have a lower fetal rate (reviewed by Geist 1971). The fetal rate as determined from the 61 ewes collected in 1972 was 0.89. The fetal rate of the 25 ewes collected in 1975 was 1.0 which is still considerably lower than the 1.38 fetal rate of other Iranian sheep populations.

Robinette (1956) reported that the net productivity of a mule deer herd should range between 20 and 35 percent and that when the net productivity falls below 20 percent one should be alerted to causative factors. Pimlott (1959) reported that a conservative estimate of Newfoundland moose (*Alces alces*) net productivity was 20 to 24 percent. Because there is no standardized method for computing net productivity, it is not possible to compare the net productivity of the island herd directly with other ungulate populations; however, our method does provide a basis for trend establishment.

## DISCUSSION AND MANAGEMENT RECOMMENDATIONS

Our conclusion that overpopulation was the primary cause of the population decline is based on a comparison of the island population in 1969–71 with the recommended stocking rates of domestic sheep on a comparable area in Iran (Central Treaty Organization 1973). Karimi (1973) classified the island vegetation as poor after an extensive vegetation study. On an area with an annual precipitation of 300 to 400 mm and poor range conditions, the recommended stocking rate for domestic sheep in Iran is 0.3 animal units per ha or 3.4 ha per Animal Unit Month or 39.6 ha per animal unit for 12 months. On an area the size of Kabudan Island (approximately 3145 ha) the recommended stocking rate would be 79.4 animal units or 476 sheep (1 animal unit is equivalent to 6 sheep) for the entire island for 1 year's grazing. Thus the island herd began the winter of 1970–71 with a population at least 6 times greater than recommended. This probably occurred due to the removal of domestic sheep, favorable weather conditions, and the absence of hunting. The herd, no doubt, began the winter of 1970–71 in poor condition due to the poor range conditions engendered by the large population. These conditions resulted in the first recorded population crash over the winter of 1970–71.

In August 1971, the population of 1865 was still approximately 3 times the recommended number. The insignificant amount of rain which fell during the spring and summer of 1971 reduced the food supply of the herd. During the 5 month period between May and September 1971, only 7 mm of rainfall were recorded compared to 79 mm and 29 mm during the same period in 1972 and 1973. Furthermore, the population faced a severe winter in 1971–72. During

the period of November 1971, through March 1972, 255 mm of precipitation were recorded on the island compared to 167 mm during the same months in 1972–73. During those months most of the precipitation falls as snow. Heavy snows, associated with strong winds, fell on the island as late as 19 March 1972. The dry spring and summer of 1971, the overgrazed condition of the vegetation, and the severe winter that followed were major factors contributing to the die-off that occurred over the winter of 1971–72. As is evident from the 1972 trapping data, and as would be expected, the lamb crop suffered the greatest losses with less than 1 percent surviving the winter.

The overpopulation of sheep on Kabudan Island is similar to that of other ungulate populations on islands without diverse population-regulating mechanisms (reviewed by Klein 1968). The leopard population of no more than 3 and the limited annual hunting harvest were insignificant regulating factors. Except for 1970 when 173 sheep were harvested, the annual number of animals removed by hunting did not exceed 100. As with the reindeer (*Rangifer tarandus*) die-off on St. Matthew Island (Klein 1968), the overgrazed range conditions interacting with climatic factors were the most likely population-regulating mechanisms on the wild sheep population of Kabudan Island.

In order to improve the range conditions and the quality of the wild sheep population, the island herd should be reduced to approximately 500 animals. Because the island is within a national park and hunting is prohibited, hunting as a method of removing excess animals cannot be used. The most efficient method of removing animals and the least disturbing to the island herd are the self-trapping devices. Wild sheep are the most numerous big game mammal in Iran. The wild sheep herd on Kabudan Island offers an excellent opportunity for the Iran Department of the Environment to study intensively the ecology and behavior of a wild sheep population and to apply these findings to its wild sheep management programs.

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